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EVALUATION OF THE REPORT ON
INTERCEPTOR SEWERS AND SUBURBAN SPRAWL

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**EVALUATION OF THE REPORT ON
INTERCEPT SEWERS AND SUBURBAN SPRAWL**

**U. S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF PLANNING AND EVALUATION
JANUARY 1975**

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EXECUTIVE SUMMARY

The Council on Environmental Quality (CEQ) has issued a report entitled Interceptor Sewers and Suburban Sprawl prepared by Urban Systems Research and Engineering, Inc. (USR&E). The central conclusion of the study is that the procedures employed in the physical design, review and financing of interceptor sewers result in the construction of significant excess capacity and thereby foster the low-density development of land.

The study was based on: (1) an analysis (conducted in the summer of 1974) of 52 interceptor projects in EPA Regions II, IV, and VI; and (2) case studies selected from the larger sample.

EPA formed a study group after the release of the report to evaluate its conclusions and recommendations. The group relied on both Headquarters program offices and Regional Offices for information on interceptor projects and also conducted its own survey of 74 projects selected randomly from 700 projects. The major conclusions of the study group are:

- The basis for USR&E's conclusions is open to question in a number of cases. All the projects reviewed were underway prior to the revision and adoption of the final Title II Regulations and the Guidance for Facilities Planning. As USR&E acknowledges, the projects selected for review were heavily biased in favor of those involving large amounts of vacant land.
- The report identifies a number of problems of which EPA has been aware for some time and has already tried to correct, primarily through the revision of the regulations and guidance governing the grant programs. We support continuing efforts in this area.
- Two of the reports major recommendations--limiting the design life of interceptor sewers to some arbitrary number of years, and limiting Federal financial assistance to that portion of interceptors needed to serve existing populations--are not appropriate:

- The design period for interceptors was found to be excessive in several cases. Also, sound cost-effectiveness analysis was found to limit design periods to twenty-five (25) years in many cases. Nevertheless, since design periods greater than twenty-five (25) years would be cost-effective in some cases, the design life should not be limited to some arbitrary number of years, e.g. twenty-five (25). Competent cost-effectiveness analysis should continue to be the determinant of the appropriate design period in each case.
- It would not be appropriate for EPA to limit its financial assistance to that portion of sewer project costs that apply to serving the needs of the existing population. A limit of 25 years, however, may allow for cost-effective solutions in most cases, and could be desirable for budgetary and policy reasons. On the other hand, such a policy could have drawbacks. The consequences of adopting such a limit should be explored through extensive public hearings.

A more detailed summary of our evaluation of the major USR&E findings and recommendations follows, together with our assessment of their policy and resource implications.

DETERMINING APPROPRIATE CAPACITY

- EPA interceptor projects sewer large amounts of vacant land.
While the EPA random survey confirmed USR&E's finding that half of the land served by interceptor projects is vacant, further analysis indicated that much of this sewerage was unavoidable in the design of particular projects, for example, to conform to EPA's policy of regionalization. Also, the study group finds that USR&E's implication that 50 percent of EPA's construction funds were used to finance excess capacity serving vacant land is completely erroneous. In the study group's random survey only 16 percent of the construction funds were obligated to

finance interceptor construction; moreover, less than 10 percent of the funding for interceptors was for excess capacity to serve vacant land. We conclude that "amount of vacant land sewered" is not a viable measure of cost effectiveness and that EPA should not issue regulations in response to this USR&E finding.

- Design life of interceptors should be reduced from 50 years or more to 25 years or less.

Current EPA policy, as contained in the Title II Regulations, requires that design life of interceptors be determined by cost-effectiveness analysis and environmental considerations -- not by any preset period. The study group contends that, although a 25-year design life is appropriate for most projects, it should not be made mandatory. Indeed, no standard planning period should be specified because some projects are likely to be more cost effective with a longer design period.

- Standards for per capita flow should be reduced through more careful analysis.

The study group found several cases where design flows cited by USR&E appeared to be excessive if viewed only on the basis of gallons per capita per day (gpcd). Further research, however, indicated that the design was often justified by other factors. In a number of projects, for example, sanitary sewers were combined with storm sewers, which required higher capacity. In other situations, high levels of inflow and infiltration (which could not be reduced on a cost-effective basis) necessitated large capacities. The study group determined that any problems

in this area should be solved by more effective facilities planning. We agree with the report's conclusion that no arbitrary standards should be set for gpcd and that design flow for each project should be based on rigorous individual analyses.

● Population forecasting techniques should be improved.

The study group basically favors this recommendation.

We recommend that EPA take steps to improve its forecasting capability, including the development of a comprehensive "state-of-the-art" manual for design engineers.

Our solution to these problems, the full implementation of EPA's Guidance for Facilities Planning (with appropriate revisions), would mean a more thorough review of Step 1 facilities plans. This would not only require additional EPA resources, but may also be interpreted by the States, grantees and consulting engineers as a further federal intrusion on local prerogatives.

FEDERAL FUNDING POLICY

USR&E contends that existing funding policy encourages overdesign and results in the inefficient and inappropriate use of available grant funds. The report, therefore, recommends that EPA limit its financial responsibility to serving the needs of the existing population. The study group believes that this policy would be contrary to Section 204(a)(5) of the Federal Water Pollution Control Act (FWPCA) Amendments of 1972, which requires that projects include "sufficient reserve capacity" to be determined largely on the basis of cost

effectiveness. Furthermore, such a limit would undermine the FWPCA's goal of achieving cost effectiveness in the construction of waste treatment works, be unfair to future grantees, and generate intense adverse reaction.

Alternatively, the study group examined a policy of limiting Federal financial assistance to 25 years of growth. Our preliminary analyses indicate that a 25-year design period could accommodate a cost-effective solution in most cases, and to that extent such a policy would be in keeping with existing legislation. In those cases where a cost-effective design period would exceed 25 years, however, the limit could be open to legal challenge.

Faced with the size of the national need for waste treatment facilities, a specific limit on the Federal funding responsibility could help to insure that Federal funds are spent efficiently to achieve the intended purpose of the Act and to insure that some Federal support is available to a larger number of communities. On the other hand, a 25-year limit could work unfair hardships on some communities, for example, large urban areas where cost-effective solutions tend to exceed 25 years. Also, interceptors are only one element of the Municipal Wastewater Treatment Works Program. Fundamental changes of policy with respect to interceptors should only be made as a part of the policy framework for the entire program. Such a broad evaluation was outside the charter of the study group. Finally, even a 25-year limit is likely to meet with an adverse reaction. Consequently, we recommend that the full ramifications of a 25- year limit be explored through extensive public hearings.

IMPROVED CONSIDERATION OF ENVIRONMENTAL IMPACTS

- Secondary environmental effects of interceptor construction should be considered.

USR&E contends that because interceptor construction could have potentially serious secondary environmental effects, particularly with regard to development of vacant land, grantees should be more conscientious in the coverage of environmental impacts in their facilities planning. Recent independent studies by EPA tend to support this conclusion. We conclude that recent EPA guidelines for facilities planning (not yet in effect for the projects studied by USR&E) should be carefully monitored to ensure that required evaluations of environmental impacts are properly carried out. Moreover, we also recommend that specific action be taken to:

- Implement the recommendations of the Construction Grants Review Group for upgrading the environmental assessment process.
 - Expedite the revision of the NEPA Regulations currently underway.
 - Develop more precise procedural guidelines for evaluation of secondary effects of interceptor construction.
- More public participation is needed in the facilities planning process.

The USR&E report suggests that grantees have failed to fully inform the public of potential impacts of interceptor construction and to provide adequate opportunity for

public input in the planning process. The study group generally agrees with this finding, but notes that the projects reviewed by USR&E were formulated prior to promulgation of EPA regulations and guidance covering public participation. We recommend that projects initiated after promulgation of the requirements be reviewed to determine if public participation has improved. In the meanwhile, we recommend that EPA express its support for the USR&E recommendations that deal with public participation.

- Increasing the level of public participation and upgrading EPA's process for preparing and revising Environmental Impact Statements could delay some project construction. State, local, and Congressional reaction to any added delays could be substantial and adverse. Additional EPA personnel would also be required.

EVALUATION OF THE REPORT ON INTERCEPTOR SEWERS AND SUBURBAN SPRAWL

I. INTRODUCTION

The report, Interceptor Sewers and Suburban Sprawl, was commissioned by the Council on Environmental Quality in order to determine the effects of the construction of interceptor sewers on suburban land use and to ascertain the extent to which the project design, review, and approval process included a consideration of these land use implications. The study, conducted by Urban Systems Research and Engineering, Inc. (USR&E) in the summer of 1974, is based on an analysis of 52 selected interceptor sewer projects in three EPA Regions and case studies of eight of those projects.

The major conclusions of the report are:

- While the absence of Federally financed interceptor sewers is unlikely to prevent low-density housing construction, their presence is an incentive to development, and the routing, sizing, and timing of new interceptor construction influence patterns of land use.
- The procedures and standards now employed in the design, review, and financing of projects provide strong incentives, both Federal and local, to design unnecessarily large and extensive interceptor projects; moreover, the procedures do not stimulate public participation and fail to ensure a careful assessment of the potential adverse secondary impacts of interceptor construction.

To remedy these problems, the report recommends that EPA:

1. Not provide Federal funds for excess capacity.
2. Re-evaluate interceptor staging of projects in rapidly growing areas.
3. Use realistic standards for estimating per capita flow.
4. Improve population forecasting techniques and review procedures.
5. Require coordination of environmental effects of interceptor induced land use.
6. Increase public participation in the planning process by publicizing community costs and benefits of interceptor induced growth.

An internal EPA study group^{1/} was formed to:

- Review the report in terms of the accuracy of its findings.
- Evaluate the methodology of the report.
- Coordinate information on EPA's policies for dealing with the issues raised in the report.
- Develop recommendations on what actions should be taken on the report's recommendations and evaluate the potential implications of adopting any of the recommendations.

In the course of its work, the study group received the full cooperation of the Regions and several elements of EPA headquarters, which not only provided comments but also helped in the analysis of the various issues involved. The study group also conducted an independent survey of 74 projects selected randomly from a list of about 700 grants awarded under P.L. 92-500 prior to May 25, 1974. The sample involved projects costing \$730 million, of which \$115 million were for interceptor sewers (Table 1).

TABLE 1
DISTRIBUTION AND COST OF RANDOMLY SELECTED PROJECTS

<u>Region</u>	<u>Projects</u>	<u>Total cost (\$ million)</u>	<u>Cost of interceptors (\$ million)</u>
I	10	128.0	19.0
II	9	278.3	60.2
III	10	55.0	10.2
IV	5	8.5	2.3
V	10	62.7	7.5
VI	5	10.1	1.3
VII	5	55.6	4.0
VIII	5	29.9	.0
IX	10	71.3	1.0
X	5	30.6	9.6
		<u>730.0</u>	<u>115.1</u>

1/ Offices participating:

Planning and Evaluation (Lead Responsibility)
 Water Planning and Standards
 Water Program Operations
 Federal Activities
 Research and Development
 Regions

In organizing this evaluation, it seemed to us that USR&E's recommendations fall naturally into two categories. The first four impact the issue of excess capacity, or rather, the capacity for which the interceptor is designed. Our findings for these recommendations are discussed in Section II. The last two recommendations involve ensuring adequate consideration of environmental effects and are dealt with in Section III. Several appendices are attached with supporting information, including Regional comments (Appendix A).

II. EXCESS CAPACITY

The USR&E report concludes that the factors and assumptions used in the physical design of interceptors result in excessive capacity in response to local development pressure. This excess capacity services large tracts of vacant, developable land, and thereby fosters low-density development. Not only does development bring with it a broad range of environmental problems, but USR&E believes that low-density development is the least economical form of development of all.

VACANT LAND AND POPULATION DENSITY

The USR&E report was designed to analyze the land-use impact of interceptors and, therefore, focussed on the question of vacant land.^{2/} Much of the discussion concerns the sewerage of vacant land and one finding is that in the projects analyzed, over half of the interceptor costs were for sewerage vacant land. This is based on the assumption that it costs no more to sewer developed land than to sewer vacant land.

In one sense, the results of our independent survey tend to support USR&E's conclusion that large amounts of vacant land are being sewerage--about 54 percent of the service areas of our projects. Nonetheless, we conclude that the amount of vacant land sewerage is not a crucial element of the problem.

^{2/} Defined as developable land with a gross density of less than approximately one dwelling unit per ten acres.

Our conclusion is based on three factors. First, USR&E equates the percent of vacant land in a service area with the percent of project costs. Our data indicate that even though 54 percent of the service areas of projects used in our survey is vacant, only about 16 percent of the total cost is for interceptor sewers. Moreover, the Regional Offices estimate that the cost of providing excess capacity for vacant land is only 9.4 percent of the interceptor sewer costs. Even allowing for a very considerable margin of error, 3/ the cost estimates in our survey certainly raise doubts about USR&E's contention.

Second, the real question is not the total amount of vacant land sewered, but the amount sewered at the local planner's option. Our survey revealed that in almost every project involving vacant land, a portion was sewered as a result of EPA's policy of regionalization. In such cases, sewer lines, of necessity, traverse vacant land in tying together one or more collection areas. They can also cross vacant land in connecting collection areas to the treatment plant. Therefore, the percentage of vacant land sewered at the planner's option is considerably less than implied by the study. The difficulty of determining how much vacant land is sewered optionally and how much through necessity makes "total vacant land sewered" a questionable evaluation criterion.

3/ A considerable error is likely because of the problems the Regions had in determining exactly what portion of expenditures were for vacant land in various projects. Nevertheless, it is apparent that the true cost of providing excess capacity to serve vacant land is relatively small.

Finally, and most importantly, it is questionable whether EPA should attempt to turn the construction grants program into a tool to control local land use. Not only was that not a stated purpose of the Federal Water Pollution Control Act Amendments of 1972, but there is a limit to the extent to which EPA should intervene into matters of local development.^{4/} At most, EPA should play a supportive or complimentary role. In this respect, EPA is currently working on an interagency agreement with the Department of Housing and Urban Development (HUD) to link EPA's Section 208 areawide waste treatment management planning with that of HUD's Section 701 program.

The vacant land discussion does raise one important issue for EPA policy, however--whether or not to sewer, and when. USR&E concludes that if land is 50 percent vacant, the installation of sewers is a wasteful expenditure. We would grant that under such conditions, the unit cost of sewers, per dwelling unit, may be greater than in more fully developed areas. However, it does not follow that sewerage is therefore wasteful. In the past, even though government subsidies have not been significant, communities with 50 percent or more vacant land have found it worthwhile to finance collection sewers and interceptors for a considerable share of homes (Appendix B).

^{4/} See "1974 Report on National Growth and Development", Department of Housing and Urban Development, for a detailed discussion of local planning and the proper role of the Federal government.

Using an alternative measure of stage of development, Appendix B suggests provisionally that for population densities of over 750 persons per square mile, interceptor projects could be assumed justified without great chance of error. Conversely, projects with lower population densities might warrant further inquiry. Applying this criterion, 24 projects out of 51 studied warranted additional examination (Appendix C). Examination of the low-density projects in Region VI--the only Region submitting project justification information--revealed that Federal financial assistance can reasonably be justified for such projects on the basis of health or other considerations. Nevertheless, further work is needed to provide guidelines on when it is cost-effective to sewer.

Given the decision to sewer, EPA faces questions regarding excess capacity: (1) what is the cost-effective capacity for which interceptors should be designed, and (2) should EPA provide matching funds for any excess capacity, and if so, how much?

The design capacity of an interceptor sewer is primarily a function of the design period, the assumed flow rates, and the expected population growth over the design period. The problem of excess capacity is discussed further in these terms.

DESIGN PERIOD

Current EPA policy, based on the Federal Water Pollution Control Act, requires that the design period for interceptor sewers be established on a case-by-case basis through cost-effectiveness analysis and the consideration of environmental impacts. Under this policy, design periods vary considerably--from about 20 years to 50 or more years.

USR&E conducted analyses comparing the present worth of project costs for 25- and 50-year design periods to approximate the least cost solution. The analyses indicate that a 50-year design period is not necessarily more cost effective than a 25-year design period. At higher interest or discount rates, higher growth rates, and lower anticipated future costs of phased construction, a 25-year period becomes economically more efficient. Based on these findings, USR&E recommends that the design period for interceptor sewers not exceed 25 years.

Our own analyses again tend to confirm USR&E's results in part, although our basic conclusion is that the determination of the cost-effective solution is an extremely complex procedure that generally has to be done on a case-by-case basis. USR&E considered three independent variables in calculating a project's present worth:

(1) interest or discount rates; (2) growth rates; and (3) the penalty cost defined as the cost of providing an increment of capacity in the future relative to the cost of constructing it today. A fourth factor which measures the elasticity of cost with respect to capacity, the economy of scale factor, was independently computed.

Cost-effectiveness calculations are highly sensitive to the assumed interest or discount rates, as is well known, and the Office of Management and Budget sets government-wide policy on the assumptions to be used. The study group's evaluation, however, focussed on the economy of scale factor as a key figure that was possibly the most difficult to determine. USR&E derived a factor

of 0.49, meaning that the capacity of a project could be increased by 10% for an additional cost of 4.9%. This factor was properly caveated in that the wide scatter of the data weakened the validity of the average. However, USR&E used the factor as a constant applicable to all interceptors projects in different parts of the country, with different capacities, etc.

To test USR&E's findings, three independent evaluative efforts were undertaken. The first, conducted by the Water Planning Division, tended to confirm the USR&E findings (See Appendix D). A family of 12 curves was derived that relates interceptor sewer costs to design capacity under different growth assumptions, discount rates and penalty factors. Essentially, the curves indicate that costs for a 25-year design period do not differ greatly from those of a 50-year period in cases where (1) annual flow growth rates are less than 0.05, (2) discount rates are less than 8 percent and (3) the penalty factor is less than 2.0. The economy of scale factor used, derived from EPA cost guidelines, was 0.50, very close to the figure developed by USR&E.

A parallel evaluation, undertaken by Region II, developed findings that differ significantly from those of USR&E (Appendix E). For instance, the economy of scale factor for the more common interceptor sizes (15" through 42") was determined to be 0.20. Region II also reviewed the methodology employed by other sources cited in the USR&E report and concluded that the cost/flow formulas used are not appropriate, primarily because they do not consider the effect of pipe depth upon excavation, pipe, and manhole costs.

The third evaluation, made by Louis Koenig Research (Appendix

F), 5/ may offer a clue to reconciling the conflicting findings. This study, commissioned by the Office of Planning and Evaluation, provides cost/flow relationships for a wide range of flows in a variety of areas at different stages of development (Table 2). These data, based on a nationwide statistical sample of 431 sewer jobs, involving 2 million lineal feet of pipes, demonstrate that the economy of scale factor is not constant, as suggested by USR&E, but, instead, varies greatly both with the extent to which the area is developed and pipe capacity. In the case of developmental characteristics, the data show that to double the flow from 1 million gallons per day (mgd) to 2 mgd in a new residential area (or to double the design period from 25 years to 50 years, assuming linear growth) would cost an additional 30 percent. To double the same flow in a central city would cost only an additional 17 percent. On the other hand, larger flows, which involve the more common interceptor pipe sizes, the cost savings are less. For example, to double the flow from 40 mgd to 80 mgd in a central city area would cost an additional 55 percent. Further, in these ranges of higher flow the economies of scale do not vary greatly among areas of different developmental characteristics.

This is not to imply, however, that construction costs for the same work do not vary greatly. Koenig identifies regional differences as well as differences based on levels of development. To obtain costs for different regions of the country, the figures in Table 2 must be adjusted by 2 factors (Table 3). Two examples demonstrate how they are applied. The regional modifier cost index for the New York region are 1.6992 and 256.33 respectively. The product of these is 435.55, which is the measure of sewer costs in the region.

5/ Louis Koenig Research, Study of Sewer Investment and Operating Costs, June 1974, (EPA Contract No. 68-01-1519).

TABLE 2

COST/FLOW RELATIONSHIPS FOR INTERCEPTOR SEWERS*

Flow (mgd)+	Open country	New residential	Sparse established residential	Dense established residential	Commerical and central city
(\$ per lineal foot)					
1	12.0	10.7	12.8	16.4	19.0
2	15.6	13.9	16.4	19.9	22.3
4	21.7	19.3	22.3	25.0	29.0
8	31.3	28.3	32.0	36.5	40.0
10	35.3	32.3	36.2	40.8	45.0
20	54.0	50.0	55.0	61.0	66.5
40	84	80	87	94	103
80	132	127	137	148	162
100	155	150	160	171	189
200	255	247	263	280	308
400	452	420	436	480	515
800	760	740	780	830	875
1,000	900	880	930	1000	1050

*Sewer Cost index = 185
 Regional modifier = 1.0
 + Million gallons per day

TABLE 3

**REGIONAL MODIFIERS
AND SEWER COST INDICIES**

Region	Controlling city	Regional modifier	April 1974 sewer cost index
1	Atlanta	1.4474	191.07
3	Birmingham	1.2600	186.16
5	Chicago	1.1718	222.19
6	Cincinnati	1.0764	212.62
7	Cleveland	1.7366	228.02
8	Dallas	1.1349	173.31
9	Denver	0.7206	179.57
10	Detroit	1.4036	237.38
12	Los Angeles	1.1430	226.06
13	Minneapolis	0.8718	218.01
14	New Orleans	1.0214	178.67
15	New York	1.6992	256.33
17	Pittsburgh	1.2811	222.32
18	St. Louis	1.6557	202.95
19	San Francisco	1.0716	231.75
20	Seattle	1.6360	209.56

The corresponding product for the Minneapolis region is 190.06. Translating these into comparative costs, an average sewer project that costs \$19,006 in the Minneapolis regions would cost \$43,555 in the New York region.

Based on these calculations we partly agree and partly disagree with USR&E's findings. Most of the curves developed indicate that there seems to be a range of years for which interceptor sewer design costs differ only slightly. A design period of 20 years is at the lower end of this range and produces cost-effective solutions in fewer cases than a period of 25 years. Design periods for interceptor sewers should not be confused with those appropriate for treatment plants. Generally, those for treatment plants are substantially lower. An analysis prepared by the Water Planning Division indicates that for most treatment plants an optimal design period is about 10 years.

Recommendations

The results of our evaluations indicate the need for caution. Although the derived average costs are reasonably accurate for typical projects, it must be recognized that costs for individual projects may vary considerably from regional norms if unusual site conditions or requirements prevail. Furthermore, it is clear that the calculation of cost effectiveness requires sophisticated analyses involving variables that are not always well understood. The problems reviewed here are so central to cost-effectiveness analysis and policy planning that they warrant additional attention. We recommend that the primary factors influencing cost-effective design periods be provided additional examination. For these reasons, we do not

believe that 25 years or any other specific time horizon should be adopted as a standard for the design period. Instead, we recommend that the design period be determined, as required by present policy, on a case-by-case basis through cost-effectiveness analysis and the consideration of environmental impacts.

FLOW RATES

The capacity of an interceptor is not only a function of the length of time for which it is designed, but also of the expected rate of flow. USR&E recommends that realistic standards for per capita flow be established.

The USR&E analysis indicates that grantees often used outdated engineering concepts in designing sewers, and in many cases, used excessive gallons per capita per day (gpcd) flow figures. In other cases, the analysis suggests, grantees made little attempt to determine what the actual flow for a sewer would be. Instead, they relied on a traditional standard of 100 gpcd. USR&E states that, in most instances, this arbitrary standard is probably excessive and that more precise analysis of capacity needs would lead to lower figures for many projects.

Overall, we agree that 100 gpcd is not an accurate measure of actual sewage flow. The figure, however, is not an "EPA standard" as implied by the report. It is a standard recommended for use by certain State and interstate engineering groups where accurate data are not available.

The USR&E report further argues against the assumption made in some designs that per capita water use will increase in the future. This depends upon whether we are looking at a community with or without an adequate sewage system. Historically, it has been proven that per capita water use will increase when a population, formerly served by septic tanks, is sewered. It is possible to produce studies showing that average usage has been increasing over the past decade. It is also possible, however, to show that average use may decrease over the next decade if the price of water increases. Our analysis indicates that there is no single solution to this problem, and that an overall cost-effective sewer design will include examination of present water usage, projected water price increases or decreases, and other regional differences which can affect water usage.

In some cases, USR&E reports, excess gpcd has been assumed to allow for future growth in areas which have not reached their ultimate level of development. In general, we agree with USR&E's conclusion that gpcd estimates should not include arbitrary allowances for growth. Good engineering practice should address growth as part of the overall analysis of excess capacity over the planning horizon selected for the interceptor project, and not on an arbitrary inflation of gpcd values to cover potential "growth".

The data collected for our independent survey confirm that the "apparent" per capita flow rates for EPA funded interceptor projects are quite high. The apparent per capita flow rate is

determined by dividing the design capacity of the sewer (minus "industrial flow") by the design population to be served.

It is improper to assume, however, that EPA grantees are using arbitrary standards (such as 100 gpcd or more) simply because the apparent per capita flow is higher than a flow based on actual water usage. Application of good engineering practice, taking into account a variety of factors in addition to actual per capita water usage, may result in higher flow figures.

Such factors include:

- The needs of commercial and institutional water users in addition to "industrial".
- Possible infiltration/inflow problems.
- Combined sanitary and storm sewers.
- Peak-loading considerations

Commercial and Industrial Users

USR&E suggests that the seemingly high per capita flows provided for in many EPA financed projects are unnecessary to satisfy existing residential needs and, as a result, provide excess capacity for future growth. One factor which USR&E does not appear to consider in making this statement and which helps explain the level of capacity, is the inclusion of non-residential users. Aside from industrial users, who are factored out of the design capacity as a separate element, certain other significant non-residential users are often included, for example, hospitals, schools, and commercial enterprises. The presence of any such large institution or business in a planning area can greatly increase the required level of gpcd built into the system.

Infiltration/Inflow

A design for an interceptor may include additional capacity to handle ground water infiltration and inflows from other sources if the analysis indicates that it would be more cost-effective to build a bigger interceptor than to correct infiltration/inflow problems. The apparent per capita flow figures in such cases would appear to be exaggerated if the calculation were done as indicated above.

Combined Sewer Flows

Calculations of apparent per capita flow are also greatly biased if the sewer combined sanitary and storm sewer flows, as has been the case in many older communities in the Northeast. The additional capacity required to handle storm runoff often exceeds that required for sanitary sewerage.

Peak-Loading

In general, sewers are designed to handle the maximum flow expected in a given service area in the design year because the pipe size must be sufficient to transmit the instantaneous flow rate (peaking factor), not simply the average flow taken over a period as long as a full day. Good engineering practice, therefore, dictates that sewers be designed to handle peak-loadings.

USR&E recognized the existence of this factor but failed to treat it as a variable in its cost-effectiveness analysis. The factor decreases with increase in population served -- from about 5 for low populations to about 2 for large populations.

Recommendation

The engineering aspects of the gpcd issue appear to have been partially satisfied by the adoption of the Title II Regulations and the supplemental Guidance for Facilities Planning, which require consideration of all the factors discussed above. We recommend, however, that EPA provide additional specific guidelines to discourage the use of arbitrary criteria such as 100 gpcd and insist upon rigorous case-by-case cost-effectiveness analysis.

POPULATION FORECASTS

USR&E concludes that grantees often use poor criteria for making population projections for interceptor sewers. Because this results in questionable growth predictions, USR&E asserts that sewers were, on many occasions, designed for populations that would never materialize or which would not develop until many years after the selected design date. Our evaluation indicates that interceptor projects are being designed for 40 or 50 years of growth. We believe that USR&E's average of 105.5 years to ultimate capacity seems to overstate the design situation.

EPA policy, as contained in the Guidance for Facilities Planning, is that regional and State planners are responsible for predicting population and encourages planners to use those prediction techniques

most likely to provide accurate estimates. The guidance emphasizes that predictions should be consistent with and based on disaggregation of current national or regional projections and cites the Bureau of Economic Analysis reports (Series E) or State projections as the most appropriate sources. More specific rules would be difficult to establish due to the wide variation of factors that might have to be considered in different planning situations.

Nevertheless, there is good reason to believe that EPA should attempt to upgrade the procedures used for developing projections. One problem is that the reliability of the projections declines rapidly with the length of the design period. A projection for 50 years is more than twice as uncertain as a projection for 25 years. A second problem is that reliable trend and growth estimates are often available only for a larger area than the potential service area requiring projection. Since averages can (and do) mask sharp variations in growth rates, even among different parts of a metropolitan area, the disaggregation of data is a crucial problem. California, however, provides local planners with excellent demographic information and requires that it be used in the design of interceptor sewers. It is reasonable to expect that significant improvements could be made in other States as well.

A third major problem is that the growth in population served by sewers may be a more relevant factor than the growth in population in general. The growth in population can understate the growth in population

served in certain cases, for example, in an area where homes previously using septic tanks are connected to sewers.

For the U.S. as a whole, the rates of growth in total population and in sewer population are shown in Table 4.

TABLE 4

GROWTH OF SEWERED POPULATIONS

	Population increase (millions)	Sewered population increase (millions)	Population increase (per cent)	Sewered Population increase (per cent)
1957-62	15	20	8.8	20.4
1962-68	12	22	6.5	18.6
1968-73	12	23	6.1	16.4

Source: Economics of Clean Water -- 1973, Table III-1.

For the most recent interval, the growth in population served was about twice the growth in population. If the same relationship held for individual interceptor areas, the USR&E estimate of years to design capacity -- a mean of 105 years -- could be overstated by a factor of two, if the relevant factor of the expected growth in population served is taken as the basis for the projections.

Recommendations

- o We recommend that EPA prepare a handbook on demographic projections for use in developing and evaluating population estimates for construction projects, including estimates of the population served. Such a handbook

would include a bibliography of pertinent literature as well as suggested procedures for dealing with different types of situations. It could serve as a reference work for Regional, State, and local planning offices, and consulting engineers.

- We recommend that EPA encourage State governments to provide local planners with more accurate estimates of population growth to serve as a basis for projections in potential service areas.

Full implementation of the Title II Regulations and the Guidance for Facilities Planning, which is the recommended solution to the problems discussed in this section, will require a careful review by EPA of all facilities plans. This review may be interpreted at the State and local level (and by the consulting engineers) as an added Federal "Big Brother" intrusion on local prerogatives, or even worse, on "good engineering practice." Thus, EPA's relations with these groups may be adversely affected. Additional review time and EPA manpower would be required as well.

FUNDING EXCESS CAPACITY

To this point, we have considered the planning factors that determine the ultimate capacity of an interceptor sewer: appropriate design period, flow rates and population projections. Our conclusions are:

- The excess capacity being built into EPA-financed interceptors is not as large as represented in the USR&E study.
- Where excess capacity does exist, there are often good reasons for it, e.g., it is cost effective; it is a consequence of regionalization; or it is required to protect down-stream water users.

- Improvements could and should be made in the planning assumptions to enhance the cost effectiveness of sewer projects.

We turn now to the issue of whether the Federal government should share the cost of excess capacity to serve future growth. Design and funding are related but separable issues. Appropriate capacity should be a function of cost effectiveness. The extent to which the Federal government shares the cost of providing for growth is a function of legal requirements and of policy considerations.

With respect to legal requirements, Section 204(a)(5) of the Federal Water Pollution Control Act Amendments of 1972 requires that before the Administrator approves a grant, he shall determine "that the size and capacity of such works relate directly to the needs to be served by such works, including sufficient reserve capacity." The amount of reserve capacity to be provided is to be calculated on the basis of cost effectiveness, i. e., a comparison of the costs of constructing that increment of capacity today as opposed to constructing it in the future. This clause would seem to require EPA to share the cost of the project as long as its size is cost effective. An earlier GAO opinion supports this interpretation. More recently, CEQ has concluded that the Administrator has discretion in implementing the "sufficient reserve capacity" clause.^{6/} While cost effectiveness is the primary consideration, CEQ concludes that other

^{6/} CEQ Memorandum to the Files, William Matuszeski, October 15, 1974.

impacts may be taken into account as well. The requirements of the National Environmental Policy Act, which are specifically applied to the waste water treatment grants program, further broaden EPA's obligation to take a broader set of considerations into account. Under the CEQ interpretation, the Administrator would seem to have a degree of latitude in determining the amount of excess capacity for which he is willing to provide matching Federal grants.

Given the absence of a clear-cut legal situation, an administrative decision not to provide Federal funds for anything beyond the capacity required to sewer existing populations would be vulnerable to challenge. The situation is less clear with respect to a limitation of 25 years. Certainly, in those cases where 25 years permit cost-effective solutions, such a policy would be in keeping with the "sufficient reserve capacity" clause of the Act. There are, however, cases where the appropriate design period exceeds 25 years. Whether or not EPA could implement a limit in such cases without the benefit of legislative amendments is not clear. The State of California, of course, has been working for some time under a 20-year cutoff policy. EPA has supported the State and has not encountered a legal challenge. It should be recognized, however, that the policy was imposed and is largely enforced by the State -- not EPA.

Limiting the Federal funding responsibility also involves a number of policy considerations. Not the least of these is that interceptors are only one element of the wastewater treatment program. Decisions of this magnitude should not be made without consideration of the effects on other parts of the program. While we have some indications that a

a 10-year design period may accommodate cost-effective solutions for treatment plants in many cases, we have not really examined the other elements of the program from this perspective.

We see little merit in USR&E's recommendation to limit Federal funding to that part of interceptor construction which is designed to serve the needs of the existing population. Such a policy could easily weaken the incentives for municipalities to participate in the program, and thus undermine the whole purpose of the grants. To the extent that planners would be tempted to conform the design period to the extent of Federal matching, plants could be constructed that would be undersized soon after they go into operation. Such plants would not only violate every concept of cost effectiveness and sound engineering, but would also contribute little to the goal of cleaning up the Nation's waterways. Finally, an extremely adverse reaction could be expected from States, potential grantees, the engineering community and the Congress.

We see more merit in a limit of 25 years. To the extent that EPA supports projects only to the point of cost effectiveness, grant dollars would be used most efficiently. While less Federal support per project would not yield overall savings, it would permit more projects to be supported. A greater number of smaller projects could not only be completed sooner but could contribute to the abatement of a larger portion of existing pollution.

There are several drawbacks, however, to a 25-year limit with respect to those cases where a cost-effective design period exceeds 25 years. Unfortunately, we have not been able to estimate with any

precision how many such cases there would be, how many years, on the average, would be required for cost effectiveness, or how much additional cost might be involved. One question involves State and grantee reaction to such a policy. A limit on Federal funding could create an incentive to limit the design period to a commensurate 25 years to the detriment of sound, cost-effective planning. Possible solutions to this problem are: (1) to require cost-effective planning periods, even when longer than 25 years; (2) to convince the grantee to build the excess capacity at his expense; or (3) to provide a waiver to the 25-year policy. The State of California and Region IX have elected to handle the problem through convincing grantees of the merits of a longer design period. Region IX believes that this approach has been reasonably successful. How successful this would be elsewhere, however, is open to debate. In New York, for instance, where the modified sewer cost index is nearly double that of California, intense resistance to this approach could develop. Secondly, the limit on funding could create incentives to try to maximize the designed capacity within the 25-year period. Hopefully, such problems could be minimized by improved procedures as recommended above and more thorough review of facilities plans. A third problem area concerns the additional burden thrown on some communities by such a policy. Not only would questions of equity be raised but State or local authorities may encounter difficulties in raising the additional amounts. Finally, it should be recognized that this evaluation addresses only a small number of the issues associated with the construction of interceptor sewers. More comprehensive coverage

is provided by the Construction Grants Review Group's recently released report, Review of the Municipal Waste Water Treatment Works Program.

Alternatives for Funding

EPA has three basic alternatives with respect to funding excess capacity to accommodate future growth:

Option 1. Provide no funding for excess capacity to accommodate future growth (USR&E recommendation).

Pro:

- Would permit construction grant funds to cover more projects.
- Would tend to discourage communities from designing interceptors with large capacity.

Con:

- Could result in inefficient, undersized interceptors.
- Would elicit intense adverse reaction from municipalities, States and Congressional interests.
- Would lead to a proliferation of small waste treatment systems resulting in (1) substantial sacrifice of economies of scale, (2) aggravation of the trained plant operator problem and (3) increased operation and maintenance problems.
- Could frustrate pollution abatement efforts in growth areas where Federal funding is most critically needed.
- The increased planning, design and construction activities resulting from more frequent treatment works expansions

would present future administrative difficulties.

- Would probably require a legislative amendment for implementation.
- In all cases would require EPA to convince reluctant grantees to fund the costs of excess capacity required by cost-effective design, which may be difficult for many grantees.

Option 2. Provide funding for moderate excess capacity to accommodate future growth expected over a 25-year design period.

Pro:

- Would spread available Federal funds over more projects.
- Would tend to foster the use of grant funds in a cost-effective manner in most cases.
- Would continue to encourage regionalization where such an approach is cost effective.
- Could have a beneficial effect by resulting in earlier achievement of water quality goals.

Con:

- In cases where cost-effective analysis calls for a design period greater than 25 years, the policy might (1) present legal difficulties and (2) place EPA in the position of insisting that communities construct excess capacity for which it is unwilling to provide matching funds.
- Might elicit adverse reaction from Congressional interests,

particularly the Public Works Committees.

Option 3. Provide funding for excess capacity to accommodate future growth based on cost-effectiveness analysis.

Pro:

- Adverse reaction from applicants and other interests would be held to a minimum.
- Would provide sound, cost-effective interceptor projects.
- Would not require EPA to convince grantees to install at their expense excess capacity required by cost-effective and environmentally sound solutions.

Con:

- Could create incentive for a community to justify a large design capacity.
- Could result in commitment of more Federal funds toward future rather than existing pollution abatement needs.
- Would tend to reduce the number of projects receiving Federal assistance.

Recommendation

We recommend that EPA explore a policy of limiting financial assistance for interceptor sewers to 25 years of growth. Recognizing that this involves a number of problems, we further recommend that such a proposal be made the subject of public hearings in order to foster the full exploration of ramifications and to obtain a wide range of opinions.

III. ENVIRONMENTAL IMPACTS AND PUBLIC PARTICIPATION

ENVIRONMENTAL IMPACTS

The USR&E study recommends that EPA devote much more extensive effort to considering the potential environmental impacts of its construction grants program. The study suggests that EPA prepare Environmental Impact Statements (EIS's) for a higher percentage of its projects and take steps to improve the quality of its environmental assessments. Failure to take this action will, according to the study, result in further degradation of the environment, particularly through unbridled suburban sprawl. The USR&E study contends that there is a strong correlation between the construction of interceptor sewers and the rapid development of previously vacant land.

The tie between interceptor construction and development has not been completely validated, however, and is subject to several limiting conditions. There seems to be some quantitative evidence that development of vacant land will probably proceed at a faster rate if sewers are available, but even the USR&E study admits that in many instances development is likely to occur, regardless of whether sewers are in place. In fact, the USR&E study suggests that where sewers are not available, less desirable systems for removing waste, such as small, inefficient package plants will be employed, and development will continue unhindered. Clearly, the question of the significance of interceptor sewers as a major variable in determining growth patterns will have to be evaluated on a case-by-case basis.

Nevertheless, the USR&E report seems to be reasonably

accurate in its finding that EPA could improve its performance in handling environmental impacts both in the processing of facilities plans and the preparation of EIS's. EPA has been concerned about the number and quality of EIS's in the construction grants program for some time. It was one of the considerations that led to the recently completed internal review of the municipal waste water treatment works program. The review report concludes that there is significant room for improvement in the Agency's effort to ensure the environmental integrity of the program. Similarly, Teknekron, Inc., was commissioned by EPA's Office of Research and Development to conduct a study of the subject (see Use of Environmental Analyses on Wastewater Facilities by Local Government (EPA 600/574-015)). That review contends that EPA does not require vigorous assessments of likely environmental damage caused by facilities construction, and lists a variety of faults found in project environmental evaluations. The faults included:

- Inappropriate orientation of the preparer of the report (for example, a consultant with an economic interest in seeing a project proceed, prepared the assessment).
- Lack of review of secondary effects (for example, impact on land development).
- Failure to adhere to EPA guidelines.
- Greater weight given to technical and cost factors than to environmental concerns.

Guidance on the preparation of EIS's is available (Title II Regula-

tions, Guidance for Facilities Planning, and the NEPA Regulations), but it has not been fully adequate. For instance, specific procedural guidance for evaluation of induced land use changes and other secondary impacts of interceptor and other treatment works construction were not included. EPA-proposed changes to the NEPA Regulations (§6.910(a)) are currently pending. These changes would clarify and tighten the criteria governing the preparation of an EIS.

Resources available to the program have been another major problem, since the preparation of an EIS can take up to 1 man-year of effort. EPA has shifted positions from Headquarters to Regional program offices and has requested sufficient additional resources in its budget submission to the Office of Management and Budget to prepare a total of 133 EIS's in FY 1976.

It should be emphasized that the three studies mentioned here -- USR&E, Construction Grants Review Group and Teknekron -- utilized data from projects initiated before the new guidance became effective. There has been neither enough time nor enough projects completed since promulgation of the changes to assess whether the new procedures are working satisfactorily.

Recommendations

Environmental effects of interceptor-induced land use should continue to receive top level management attention in EPA. We recommend that, after a sufficient period of time, a study be conducted to determine the effectiveness of the new procedures.

Other major steps that should be taken are:

- Timely promulgation of the revised NEPA regulations, with

particular attention to the workability of criteria for determining those cases where EIS's should be prepared.

- Insistence that grantees include analyses of potential environmental impacts of proposed projects as integral elements of their facilities planning.
- Preparation of procedural guidance on evaluation of induced land use changes and other secondary impacts of interceptor and other treatment works construction.
- Allocation of additional resources for the preparation of EIS's.
- Implementation of recommendations in Chapter IV of the Review of Municipal Waste Water Treatment Works Program.

PUBLIC PARTICIPATION

The USR&E report suggests that in the cases of interceptor projects it studied, grantees had failed to adequately involve the public in the facilities planning process. It further suggests that if the public were made aware of potentially serious consequences of interceptor projects -- in terms of future demands for public services, etc. -- the public would have greater incentive to become involved. Again, because EPA regulations and guidelines have been changed since the projects studied were in the planning stage, it is difficult to determine whether or not the alleged lack of participation is still a problem. In any case, primary responsibility for ensuring public participation resides with the grantee. The Administrator, however, is responsible

for evaluating the level of participation and determining that it is in compliance with the spirit and the letter of the law. EPA's official policy is to require public participation in all phases of facilities planning for construction grants. The basic documents which detail the requirements for citizen involvement are (1) Title II Regulations, and (2) Guidance for Facilities Planning.

The Title II Regulations specifically note that public participation is to be strongly encouraged to provide greater responsiveness to citizen concerns and to improve the public's understanding of official programs and actions. The regulations state that conferring with the public after a final decision has been made will not satisfy the intent of the law.

The Guidance for Facilities Planning provides suggested, not mandatory, guidance. The guidance complements the regulations and gives more detailed explanation of how the public is to be involved. The guidelines suggest that, as a minimum, the public participation program should contain the following elements:

- Dissemination of information materials including policy, program, and technical information and notices of intention to take action.
- Assistance to the public.
- Consultation with the public.
- Notification through formal and informal means.
- Easy access to information.

The guidelines also provide a detailed list of procedures which may be used for eliciting public interest and participation. In brief,

existing EPA policy already requires the main elements of the USR&E recommendations.

The Teknekron report mentioned earlier details some of the problems encountered in involving the public in the planning process. This study was also undertaken before adoption of Title II Regulations and the Guidance for Facilities Planning and hence the results do not take into account any possible changes since that time. It does, however, support the contention of the USR&E report that EPA has not been completely successful in its attempt to encourage public participation in the planning process and makes recommendations similar to those developed in the USR&E study for reducing the problem. Although there are some reports of greater levels of participation in recent months for some projects (particularly in Texas and in California) it is not clear whether this indicates a nationwide trend. It is also unclear if the improvements are traceable to the changes in the EPA requirements or to some other factor.

Recommendations

We are in full agreement with the findings of the USR&E study on public participation. The question is whether the recent steps taken by the Agency have been effective in improving public participation. In view of this question:

- We recommend that EPA compile data on construction projects initiated after adoption of the Title II Regulations and the Guidance for Facilities Planning to determine if public participation has improved. If it has not, an evaluation should be made to determine the causes of the

problem and to develop recommendations for improving the system. In the meantime, we recommend that EPA support the recommendations made in the USR&E study that deal with public participation and make it clear to State agencies and grantees that increased emphasis will be placed on adherence to the provisions of the Title II Regulations and the planning guidelines. EPA should stress that local governments have a major responsibility to disseminate information on all potential implications of interceptor construction, particularly with reference to likely effects on land use and environmental concerns.

Nevertheless, it should be recognized that a low level of public participation is not necessarily the fault of either EPA or the grantees. Many projects are unlikely to generate public interest, regardless of publicity or ease of participation. While we agree that EPA should take additional steps to improve consideration of the environmental impact of interceptor construction, and support greater public participation in these decisions, these recommendations may delay construction of some projects urgently needed to correct existing water pollution problems. Reaction from the States, local governments, and the Congress to any additional delays will assuredly be very negative.